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Estimation of Growth Parameters Using Length Frequency Data of Whiting (Merlangius merlangus euxinus, Nordmann 1840), from Black Sea Coasts of Turkey

Hakan Aksu*

[a]*Department of Fisheries, Sinop University Vocational Schools, Sinop, Turkey*
**Corresponding author, example@gmail.com*

ABSTRACT: The growth parameters of whiting (M. merlangus euxinus, N. 1840) were estimated using length frequency data collected by trawl fishing in the Sinop region, Turkey during September 2009 to April 2010. A total of 7716 whiting was sampled monthly, ranging from 3.2 to 26.6 cm in total length (mean 14.09±0.03 cm). The Length-Weight relation calculated that W=0.0047 L 3.1694 (r2=0.97) for females and W=0.0058 L 3.077 (r2=0.96) for males. The regression coefficient "b" exhibits positive allometric growth ($p<0.05$, t= 2.91) for females and isometric growth ($p>0.05$, t= 1.75) for males. The mean condition factor (K) for females and males was determined 0.74±0.0046 and 0.71±0.0038, respectively. The highest condition factor was recorded 0.99 in October for females and 0.88 in January for males. The seasonal von Bertalanffy growth parameters using monthly length frequency distributions were estimated as $L\infty$ = 30.57 cm TL, K = 0.937 year-1, t0 = -2.0407 for all individuals. A growth performance index value (Φ') was estimated as 2.9423.

Keywords *– Whiting, Merlangius merlangus euxinus, growth parameters, trawl, Black Sea*

1. Introduction

Due to the increase in the human population, our world natural food sources are being depleted rapidly. Today, healthy eating problems have started to appear worldwide. Animal food sources are one of the important sources in human nutrition.

The whiting Atlantic Ocean, Adriatic Sea, Norway, Iceland and North Coast of Portugal, Mediterranean, Aegean Sea, Black Sea, Marmara Sea and Azov Sea shows a widespread (Nedreaas et al., 2014). The adults of the whiting adapted to live in 5-16 °C water (Ozdemir et al., 2018). It is found in waters at a depth of 50 meters to 100 meters and on muddy, sandy bottoms (Frattini and Casali, 1998). Life cycle occurs in the semipelagic and demersal region. Whiting up to a depth of 15-30 m in spring, whiting migrates to 120 m deep to reproduce in autumn. Reproductive migration of fish is from shallow to deep, and the food migration is in contrast to this (Ozdemir et al., 2018, Milic and Kraljevic, 2011). Their reproduction usually lasts from November to June. It is reported that the first maturity age for the species in the Black Sea is 1 and the average total height corresponding to this age is 12-13 cm. (Genc et al., 2002). They usually lay their pelagic eggs in layers near the top of the water (Aksiray, 1987). Is the main prey and target species of bottom trawling catch in our country (Ozdemir et al., 2018). During the fishing season in the Black Sea, it is caught for almost 12 months of the year, especially with the bottom trawl. Outside the fishing season, it is fished with bottom gillnets (Bilgin and Bilgin, 2018, Ozdemir et al., 2018).

The species reaches a maximum of 70 cm. Its average length is 23.5 cm. (Nedreaas et al., 2014). Whiting is a demersal species that can be fished on the Black Sea coast throughout the year (Aksiray, 1987). The species reaches its first maturity age at the age of 3 or 4 (Cohen et al. 1990). Spawning occurs irregularly throughout the year, but usually begins in October and lasts until July-August (Bowers, 1957; Slastenenko, 1956). This species take nourishment on shrimps, crabs, molluscs, little fish, polychaetes and cephalopods. Sprat fish is a significant ingredient of the diet of Black Sea Whiting (GFCM, 2012). The amount of catches of sea fish in 2018 is 222024 tons. Whiting is the most fished species in black sea demersal fisheries (TUIK, 2020).

The amount of whiting catch amount was 6814 tons after the sprat catch amount, and it ranked sixth. The ratio of whiting catch amount to sea fish catch amount shows significant differences over the years (TUIK, 2020).

When determining the population parameters from the size composition data of a population, it should be noted that the fishing gear used is not selective. Selective fishing gear may not fully represent the population. In addition, increasing the number of samples will increase the accuracy of the population parameter estimation (Gulland, 1965). Estimating population parameters from size composition data can be considered as the correct method (Erdem, 1996).

Information about fish age, development and growth is a cornerstone in fishery research and management. Growth studies are an essential instrument in the management of fisheries resources since they contribute to estimates of production, stock size, recruitment and mortality of fish populations. In the event that age becomes too complex to be established through an observation of hard parts (otoliths, scales, opercula, rays, spines and vertebrae), information about the demographic parameters of fish and other animal populations can be obtained by length-frequency analysis (Magnifico, 2007).

Researches on whiting, which is heavily fished in all our seas, are generally carried out on prey amount, biology, population and growth parameters (Bilgin and Bilgin, 2018). The most important growth parameters calculated from the samples taken from fish populations are $L\infty$, K and t0 which forms the Von Bertalanffy growth equation (Obeida et.al., 2013). These studies are of great importance in the healthy management of stocks and their transfer to the future.

In this study, the length composition and length weight relationship parameters of whiting fish, which is one of the most important demersal species of fisheries made with bottom trawl nets and bottom gill nets in the Black Sea, were determined.

2. Material and Methods

The study samples were collected from the bottom trawler boats in Sinop fishing grounds between September 2009 and April 2010. A total of 7716 whiting was monthly random sampled in this study.

Fig. 1. The Map of Study Area

Samples were taken monthly by random sampling to represent the population. Individual total length (cm) and weight (g) measurements were made to be used in the calculation of fish-length-weight relationships. Distinction of sex was made based on gonads.

The length-weight relationship is calculated as follows using the "log-transformed" length and weight data for females and males:

Log (W) =Log (a) + b*Log (L)

The length-weight relationship W=aLb was applied female and male whiting (Ricker, 1975). The Pauly's t test is used to calculate separately for females and males.

Analysis of length data was assigned to length frequency distributions grouped in total 5 mm length classes using Length Frequency Distribution Analysis (Pauly, 1984).
From the formula (W/L 3)*100, the condition formula of the Fulton's is calculated for all genders.

Growth performance of whiting comparisons with made using the growth performance index (Φ'). These are preferred rather than using L∞ and K individually (Pauly and Munro, 1984). Growth performance is estimated with:

Φ' =Log (K) + 2 Log (L∞).

3. Results and Discussion

A total of 7716 whiting ranging from 3.2 to 25.6 cm in total length (mean 14.09±0.03 cm) (Fig. 2) were monthly sampled from September 2009 to April 2010, in the Sinop Region. 577 of 7716 individuals sampled were weighted, of which 291 were male and 286 were female. The length of male individuals is between 9 and 22.6 cm (average length is 13.06 ± 0.11 cm), while the length of 286 female individuals is between 8.9 and 18.1 cm (average 15.35 ± 0.15).

According to the results obtained, it was observed that the female individuals of the whiting were larger than the male individuals.

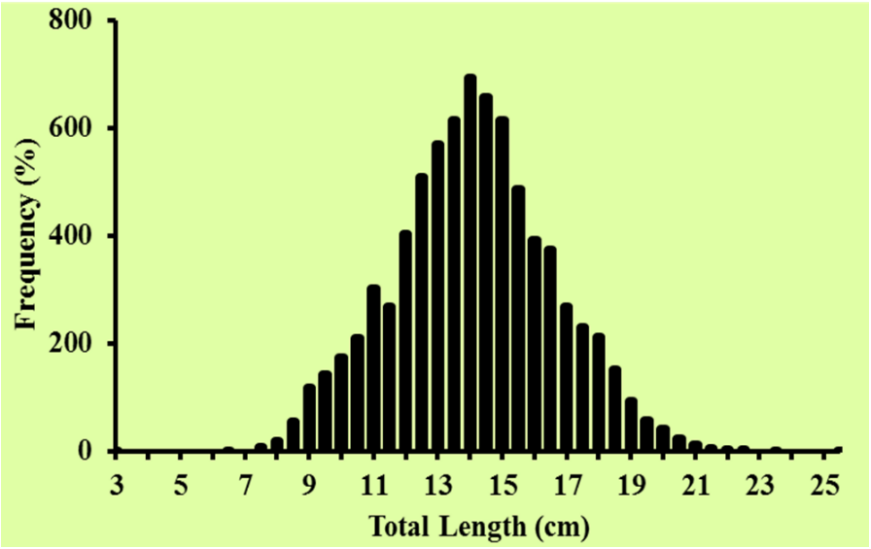

Fig. 2. Whiting Length – Frequency Distribution

The L-W relation was calculated W=0.0058L3.0777 (r2 =0.96) for males and W=0.0047L3.1694 (r2 =0.97) for females. The regression coefficient "b" exhibits positive allometric growth ($p<0.05$, t= 2.91) for females and isometric growth ($p>0.05$, t= 1.75) for males. Length weight relationship parameters were calculated as W=0.0005L2.9181 for all individuals. Negative allometric growth was observed for all individuals.

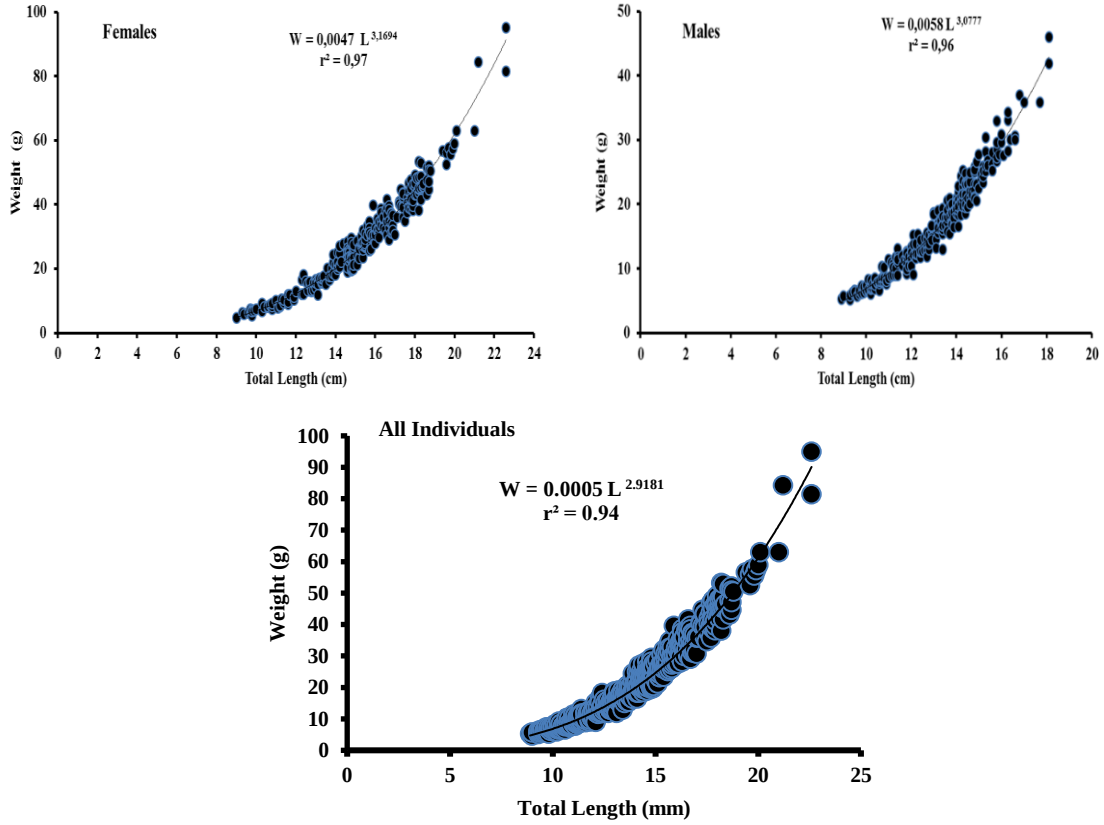

Fig. 3. Length - Weight Relationship of Female, Male and all Individuals of Whiting

Table 1. Length-weight relationship values obtained in other studies are given in the table

Researchers	***a***	***b***	***r***
Duzgunes and Karacam 1990	0.2721	2.573	-
Samsun, 1995	0.0045	3.187	-
Ismen (2002)	0.0042	3.240	0.99
Bradova and Prodanov (2003)	0.0083	2.930	0.99
Atasoy et al., 2006.	0.005	3.14	-
Samsun (2010)	0.0043	3.202	0.97
Maximov et al., (2011)	0.0048	3.106	0.99
Yankova et al., (2011)	0.0040	3.151	0.99
Saglam and Saglam, 2012	0.0064	3.0441	0.88
Ozdemir and Duyar, 2013	0.0104	2.8555	0.93
Aydın and Hacıoglu (2017)	0.0062	3.089	0.96
Calik and Saglam, 2017	0.131	2.772	0.91
Ozdemir et al, (2018)	0.0068	3.020	0.99
Taylan et al., (2018)	0.0073	3.024	0.94
Kasapoglu, 2018	0.0054	3.146	0.92
Yildiz and Karakulak, 2018	0.004	3.253	0.97

In previous studies (Duzgunes and Karacam (1990) (0.70), Samsun et al. (1994) (0.74), Samsun (1995) (0.81), and Samsun and Erkoyuncu (1998) (0.74)), values similar to CF value obtained in this study (0.71 to 0.74) were obtained. These minor differences are thought to be due to changes in the Black Sea ecosystem.

The highest condition factor was recorded 0.99 in October for females and 0.88 in January for males.

Seasonal von Bertalanffy growth parameters calculated using monthly length frequency distributions were $L\infty$ = 30.57 cm TL, K = 0.937 year-1, t0 = -2.0407. Most studies were achieved at different $L\infty$ values. These differences may be due to differences in sampling and calculation. The highest, lowest and mean condition factor (K) for females and males was determined 0.99, 0.53, 0.74±0.0046 and 0.88, 0.51, 0.71±0.0038, respectively.

Table 2. Von Bertalanffy growth equation parameters of whiting in the Black Sea

Researchers	***L∞***	***k***	***t0***	***Ø***
Duzgunes and Karacam 1990	31.9	0.203	1.9705	2.32
Samsun, 1995	39.73	0.147	-	-
Ozdamar and Samsun, 1995	29.89	0.204	-1.4393	2.26
Samsun and Erkoyuncu, 1998	35.45	0.138	-2.0428	-
Ciloglu et al., 2001	38.4	0.136	1.833	-
Ismen, 2002	37.9	0.15	1.05	2.36
Bradova and Prodanov, 2003	26.63	0.2234	1.6196	2.20
Ozdemir et al., 2006	30.29	0.2224	-	-
Atasoy et al., 2006.	38.5	0.15	-1.47	-
Samsun, 2010	39	0.114	2.193	2.24
Maximov et al., 2011	29.83	0.157	2.49	-
Saglam and Saglam, 2012	33.56	0.141	2.654	2.20
Mazlum and Bilgin, 2014	32.3	0.1735	2.258	-
Kasapoglu, 2018	33.05	0.13	-2.93	-
Yildiz and Karakulak, 2018	37.05	0.106	1.63	-

Whiting is the most fished species with bottom trawling in the Black Sea region (Bilgin and Bilgin, 2018, Ozdemir et al., 2018). In order to reveal the effect of intensive fishing on the species, it is necessary to ensure the continuity of the researches (Ozdemir et al., 2018). Previous research has shown that whiting stocks are under pressure from environmental

changes and overfishing (Prodanov and Bradova, 2003; Saglam and Saglam, 2012; Bilgin, 2018; Kasapoglu, 2018) For these reasons, it is considered that their stocks should be monitored regularly in the Black Sea ecosystem (Yildiz and Karakulak, 2018; Kasapoglu, 2018).

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